

Salmon, Steelhead, and Bull Trout Habitat Limiting Factors

**For the Wenatchee Subbasin (Water Resource
Inventory Area 45) and Portions of WRIA 40
within Chelan County (Squilchuck, Stemilt and
Colockum drainages)**

FINAL REPORT

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ACKNOWLEDGMENTS

In accordance with RCW 77.85.070 (Salmon Recovery Act, previously Engrossed Senate House Bill 2496), a Technical Advisory Committee (TAC) was organized in March 2000 by the Conservation Commission in consultation with Chelan County, the Yakima Nation (YN), and the Colville Confederated Tribes (CCT), by inviting private, federal, state, tribal and local government personnel with appropriate expertise to participate.

The role of the TAC was to identify the limiting factors for anadromous salmonids and bull trout in the Wenatchee subbasin (WRIA 45) and the Squilchuck, Stemilt, and Colockum drainages of WRIA 40 (RCW 77.85.070[3]). The information was then incorporated into this report to support the Chelan County Lead Entity Committee in their effort to compile a habitat restoration/protection projects list, establish priorities for individual projects, and define the sequence for project implementation (RCW 77.85.050[1c]).

The TAC membership mailing list was extensive. It included the following persons, although actual participation in the TAC meetings and contribution to the development of the report through draft document reviews were represented by a core group, identified here with an asterisk:

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AGENCY, ORGANIZATIONAL, AND OTHER ABBREVIATIONS

ACOE	Army Corps of Engineers
BLM	United States Bureau of Land Management
BPA	Bonneville Power Administration
CCCD	Chelan County Conservation District
CCT	Colville Confederated Tribes
CID	Chiwawa Irrigation District
CRITFC	Columbia River Inter-tribal Fish Commission
DNR	Washington Department of Natural Resources
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
GCFMP	Grand Coulee Fish Management Plan
LWD	Large Woody Debris
GIS	Geographic Information Systems
HPA	Hydraulic Project Approval
HUC	Hydrologic Unit Code
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NWPPC	Northwest Power Planning Council
NWIFC	Northwest Indian Fisheries Commission
PID	Peshastin Irrigation District
RTT	Regional Technical Team for the Upper Columbia Salmon Recovery Board
SASSI	Washington State Salmon and Steelhead Stock Inventory
SaSI	Washington Salmonid Stock Inventory
TAC	Technical Advisory Committee
UCSRB	Upper Columbia Salmon Recovery Board
USFS	United States Forest Service, Department of Agriculture
USFWS	United States Fish and Wildlife Service, Department of Interior
USGS	United States Geological Survey
WAC	Washington Administrative Code
WCC	Washington State Conservation Commission
WDOE	Washington Department of Ecology
WDF	Washington Department of Fisheries (superceded by WDFW)
WDW	Washington Department of Wildlife (superceded by WDFW)
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDA	Washington State Department of Agriculture
WDOT	Washington State Department of Transportation
YIN	Yakama Indian Nation (superceded by YN)
YN	Yakama Nation

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EXECUTIVE SUMMARY

General Information

This report addresses the portion of WRIA 45 that drains into the Wenatchee River and includes the Squilchuck, Stemilt, and Colockum watersheds of WRIA 40, all contained within the boundaries of Chelan County. The Wenatchee subbasin, Water Resource Inventory Area (WRIA) 45, drains a portion of the east slopes of the Cascade Mountains in north central Washington within Chelan County. Encompassing approximately 1,371 square miles, the subbasin is bounded on the west by the crest of the Cascade Mountains. It is bounded on the north and east by the Entiat Mountains and to the south by the Wenatchee Range. A tributary of the Columbia River, the Wenatchee River travels 54.2 miles before it empties into the Columbia River at the City of Wenatchee (RM 468.4), fifteen miles upstream of Rock Island Dam (RM 453.4), the seventh Columbia River dam upstream from the confluence of the Columbia River with the Pacific Ocean.

The Squilchuck, Stemilt and Colockum watersheds of WRIA 40 lie south of the City of Wenatchee where WRIA 40 extends northward into Chelan County. These watersheds drain directly into the Columbia River at RMs 464.0, 461.9 and 450.0, respectively. This portion of WRIA 40 is bounded on the west by Naneum and Mission ridges, on the south by Jumpoff Joe Ridge, and on the west to north by the Columbia River, Beehive Mountain and Dry Gulch.

Upper Columbia River summer steelhead, which includes the Wenatchee River run, were listed under the Endangered Species Act (ESA) as “endangered” on August 18, 1997. Upper Columbia River spring chinook salmon, which includes the Wenatchee River run, were listed under the ESA as “endangered” on March 24, 1999. Upper Columbia River bull trout, which includes the Wenatchee subbasin populations, were listed under the ESA as “threatened” on June 10, 1998. All stocks of steelhead and spring chinook in the Wenatchee subbasin identified by the state Salmon and Steelhead Stock Inventory report (SaSI; WDF/WDW 1993), are classified as “Depressed” based on chronically low production. The summer chinook salmon and the Wenatchee sockeye salmon, which both spawn and rear in the Wenatchee subbasin, are not ESA listed species and are classified as “Healthy” by the state SaSI based on escapement (WDF/WDW 1993). Coho salmon were extirpated from the Upper Columbia River region in the early 1900s. Efforts are presently underway by the Yakama Nation to reintroduce them.

In the late 1800's, overfishing on the lower Columbia River severely depleted salmon runs to upper Columbia River tributaries (Chapman 1986). By the 1930s, anadromous salmonid runs in the Wenatchee subbasin were decimated because of overfishing in the lower Columbia River fisheries and irrigation diversion practices and habitat degradation in the subbasin. Bull trout populations in the Wenatchee subbasin may also have been negatively impacted by many factors, among them, habitat fragmentation resulting from dewatering and fish passage barriers created by turn of the century water diversions. In 1939, a hatchery program was launched to offset the loss of access and mitigate for

impacts created by the soon to be completed Grand Coulee Dam. Despite ongoing hatchery programs, resource managers have not been able to reestablish the spring salmon and steelhead populations of the Upper Columbia River region to self-sustaining levels. Failure can be attributed to a number of factors including passage problems and mortality associated with seven hydroelectric facilities on the mainstem Columbia River downstream of the Wenatchee River, unfavorable ocean conditions, harvest pressures, and degradation of ecological processes and habitat within the Wenatchee subbasin (Peven, 1992; WDF/WDW 1993; Williams et al. 1996).

This Salmon, Steelhead and Bull Trout Habitat Limiting Factors Report for the Wenatchee River subbasin focuses on habitat conditions in the subbasin as they affect the ability of the habitat to sustain naturally-producing salmonid populations. It provides a snapshot in time based on the data and published material available during the development of this report and the professional knowledge of the Technical Advisory Committee (TAC). Revisions to the report are not currently funded, however it is the hope of the Washington State Conservation Commission (WCC) that the information and assessment provided here will be utilized and built upon in future subbasin planning efforts designed to promote the restoration of self-sustaining salmonid populations in the Upper Columbia River Region.

Data in the literature on habitat conditions in the subbasin are well developed for federal USFS lands, which comprise about 76 % of the total subbasin. Data regarding habitat conditions on private lands is more limited and less readily available. However, a recent fish passage barrier inventory by Chelan County (Harza 2000), an in-progress Lower Wenatchee River Channel Migration Zone survey, and the initiation of Watershed Planning under RCW 90.82, also by Chelan County, will contribute to the knowledge base on private lands. Additionally, the creation of the Upper Columbia Salmon Recovery Board (UCSRB), has greatly contributed to a coordinated and more consistent consideration of habitat conditions and priorities within the Wenatchee subbasin. The UCSRB is a partnership among Chelan, Okanogan and Douglas counties, the Yakama Nation (YN) and Colville Confederated Tribes (CCT) in cooperation with local, state, and federal partners. The mission of the UCSRB is *to restore viable and sustainable populations of salmon, steelhead, and other at-risk species throughout the collaborative efforts, combined resources, and wise resource management of the Upper Columbia River Region*. Given the available information, during the development of this report, the TAC relied heavily upon its combined professional knowledge to assess the extent to which habitat conditions affect salmonid productivity in the Wenatchee subbasin. The TAC members' knowledge of habitat-forming processes and general salmonid habitat needs provided the basis for drawing conclusions in this report.

In the short-term, projects designed to treat symptoms of habitat degradation should be implemented with caution until a long-term salmonid habitat protection and restoration strategy can be developed. Focus should be removed from treating the effects of habitat degradation (ie. reduced pool quality and quantity, habitat, cobble embeddedness, reduced levels of LWD, high instream temperatures, and accelerated bank instability) with short-lived, engineered treatments (ie. stabilizing banks, anchoring woody debris,

planting vegetation and installing barbs) to diagnosis and treatment of the causes of habitat degradation. A long-term strategy should maintain a subbasin-wide, ecosystem-based approach and define a course of action to correct those factors that are causing the habitat degradation. Section 070 of the Salmon Recovery Act (RCW 77.85), directs the Lead Entity Citizen's Committee to develop this strategy. As per this legislation, Chelan County, Lead Entity for WRIA 45, have convened this Citizen's Committee. Components of the strategy for "prioritizing and implementing salmon restoration activities... in a logical sequential manner that produces habitat capable of sustaining healthy populations of salmon" are to include project monitoring, project evaluation, and adaptive management strategies. Integrated into the context of a long-term strategy, short-term structural channel manipulations can then be more biologically effective. All structural improvement projects should be designed so the placement is appropriate for the hydro-geomorphological characteristics of the reach.

Factors Affecting Natural Salmonid Production in the Wenatchee Subbasin.

Anadromous salmonid populations in the Wenatchee subbasin are influenced by the following out-of-subbasin impacts; degraded estuarine habitat, fish harvest, unfavorable ocean conditions, and the affects of seven Columbia River reservoirs and hydroelectric dams on smolt and adult migration. Spring and summer chinook salmon, sockeye salmon, and steelhead trout must negotiate a 468 mile journey from the mouth of the Wenatchee River to the Pacific Ocean, once as smolts and again as adults. Out-of-subbasin impacts on anadromous salmonids are being addressed at the state and federal level in forums outside the salmonid habitat limiting factors assessment process presented here. The scope of this report will be limited to an assessment of subbasin habitat conditions only.

Within the subbasin, human alterations to the environment are exacerbating naturally limiting conditions by reducing habitat quality and quantity, thereby reducing a species' chances of successfully completing its life cycle. These alterations have primarily occurred in the lower gradient, lower reaches of watersheds in the lower subbasin and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversion, reduced large woody debris (LWD) recruitment, and flood control efforts that include LWD removal, berm construction, and stream channelization.

Maintaining the present level of habitat functionality and connectivity in watersheds of the upper Wenatchee subbasin is of primary importance for sustaining salmonid populations in the subbasin. This includes the Little Wenatchee/White River, Nason, and Chiwawa River watersheds where overall, habitat function is rated by the TAC as very high, with habitat concerns focused along transportation/utility corridors and on privately owned floodplains in lower reaches. Maintenance of functioning floodplain habitat may be achieved through many means, including but not limited to: conservation easements; out-right purchase from willing sellers; habitat protection ordinances; and any other means local citizens, scientists and policy makers can develop to achieve the maintenance of floodplain habitat functions. To maintain connectivity with the Nason Creek

watershed, there is also a strong need to restore floodplain function and riparian habitat in Nason Creek where state highway impacts, railroads, and utility corridors have confined the channel and reduced channel sinuosity in places.

To provide for the year-round spawning, rearing and migratory habitat needs of all life history stages of spring and summer chinook salmon, steelhead trout, sockeye salmon and bull trout, floodplain habitat along the Wenatchee River corridor must provide adequate quantities of naturally-forming, accessible, high quality, watered, off-channel habitat. Given that the level of functionality and connectivity of the upper watersheds is maintained, habitat conditions in the mainstem Wenatchee River (RM 0.0 – 54.2) have the greatest potential to affect salmonid fish production in the Wenatchee subbasin. The mainstem of the Wenatchee River serves as the corridor through which chinook, steelhead, sockeye and fluvial bull trout must pass to access habitat within the subbasin. It also maintains connectivity among the watersheds in the Wenatchee subbasin as well as with the greater Columbia River system.

Reestablishing passage at human-made fish passage barriers on Icicle Creek would provide access to a Wenatchee subbasin watershed that is mostly in a highly functional condition. This is dependent on fish passage through the boulder fields at RM 5.6 which may vary by species and with flow conditions. Reconnecting the Icicle watershed to the rest of the Wenatchee subbasin has the potential to contribute to: 1) maintaining bull trout populations and restoring the fluvial bull trout life history form to the Icicle Creek watershed; 2) reestablishing a strong, wild steelhead run in the Icicle Creek watershed; and 3) opening additional spawning and rearing habitat to spring chinook in the Wenatchee subbasin. To fully realize the potential benefits of reestablishing connectivity between the majority of the Icicle Creek watershed and the rest of the Wenatchee subbasin, low instream flows and high instream temperatures must also be addressed in Icicle Creek from the mouth upstream to RM 5.7. Habitat restoration projects aimed at restoring the channel's ability to dissipate energy and manage sediment loads would further improve salmonid productivity in the watershed. This includes restoring floodplain function and channel-forming processes within the lower 16.8 miles of Icicle Creek, and reducing human-induced sediment input.

The drainage/watersheds located in the lower portion of the Wenatchee subbasin (Chumstick drainage, Mission Creek watershed, and Peshastin Creek watershed) have been severely altered from their naturally functioning condition and are highly fragmented. Salmon, steelhead and bull trout populations in these drainages/watersheds are significantly reduced from their historic potential and, due to the existing land use activities and management issues, have less potential for recovery than watersheds in the upper Wenatchee subbasin. Among the Chumstick, Mission, and Peshastin watersheds, Peshastin Creek is of primary importance given the watershed's potential to contribute to bull trout, spring chinook, and steelhead production in the Wenatchee subbasin. The relative contribution to flows in the Wenatchee River from these drier watersheds of the subbasin is low, limiting the potential for these watersheds to contribute to improved flows in the mainstem Wenatchee River.

The Squilchuck, Stemilt and Colockum drainages of WRIA 40 are extremely low surface water producers given their arid climate and geologic condition. Fish production in these drainages are strongly affected by low water years when available moisture is limited to a brief spring runoff event with which to sustain instream flows in most reaches. In these drainages, only the lower reaches of Squilchuck, Stemilt and Colockum creeks have any potential to support anadromous salmonids, with the upper extent naturally limited by gradient and/or stream channel size and flows. These drainages are primarily or exclusively steelhead/rainbow trout waters with chinook use, when not precluded by flows, limited to “pull-in” rearing behavior by summer chinook and spring chinook juveniles migrating through the Columbia River system. However, of interest is the distribution and status of native redband trout populations in these watersheds, which may contribute to steelhead populations in high water years.

Little information exists regarding the impact of hydroelectric development in the Upper Columbia River system on bull trout, although recent radio telemetry data has documented adult bull trout living in the Columbia River are able to safely negotiate through the Rocky Reach and Wells Hydroelectric Projects (S. Bickford, Douglas County PUD, pers. comm., 2001). Earlier, Brown (1992) speculated that the conversion of the free-flowing upper Columbia River to a series of reservoir impoundments has had a negative effect on fluvial bull trout. However, maintaining self-sustaining populations of stream-resident, adfluvial and fluvial forms of bull trout within the Wenatchee subbasin is mostly dependent on providing properly functioning habitat and access to that habitat in sufficient quantities within the subbasin. Past fish harvest pressures within the subbasin, bolstered by relatively easy access, also have had a negative impact on bull trout populations in the subbasin.

Natural environmental conditions also can limit natural production of salmonids in the Wenatchee subbasin. In years when moisture availability is limited by climatic conditions, instream flows become severely reduced resulting in dewatered reaches, winter icing, and higher summertime water temperatures. Depending on the severity of the climatic conditions, the duration and extent of low instream flows and dewatered reaches can expand. These conditions restrict salmonid movements, dewater redds, and strand juveniles, resulting in direct mortality to salmonids. Catastrophic disturbances are also a natural component of this ecosystem and limit salmonid production. Landslides, floods and fire create a disturbance regime that cleanses, builds and replenishes the aquatic environment. While these events reduce habitat availability or function in one stream reach, they improve habitat conditions in another stream reach by recruiting spawning gravels and LWD while flushing sediment.

The Technical Advisory Group’s Recommendations Ranked in Order of Importance

1. **Maintain highly functional habitat in Wenatchee subbasin watersheds.** The White/Little Wenatchee River and Chiwawa River watersheds represent systems that most closely resemble natural, fully functional aquatic ecosystems. In general these

watersheds support large, often continuous blocks of high-quality habitat and support all life-history stages of multiple salmonid species. Connectivity is good among subwatersheds and through the mainstem Wenatchee River corridor is good. The immediate strategy should be to maintain properly functioning habitat within these watersheds so they can continue to support robust salmonid populations resilient to normal environmental disturbances. These populations can then to expand their range into adjacent watersheds in the subbasin.

2. **Maintain and restore habitat on the mainstem Wenatchee River.** Recent research indicates that the mainstem Wenatchee River provides important habitat for many life stages of spring and summer chinook salmon and steelhead. The mainstem at this time is most vulnerable to riparian and instream habitat degradation. All remaining habitat functions on the mainstem Wenatchee River should be protected, and floodplain functions should be restored, especially in the Lower Wenatchee River (RM 0.0 – 25.6) and particularly from the Mission Creek confluence downstream to the Columbia River confluence (UCSRB RTT 2001). This includes riparian, and off-channel habitat located in the floodplain of tributaries to the Wenatchee River in this reach (i.e. berms in the vicinity of Cashmere and Monitor; oxbows cut off by railroads and state highways along Lower Nason Creek and Peshastin Creek). The in-progress Chelan County Lower Wenatchee River Channel Migration Zone study, once completed, should assist subbasin planning efforts to more confidently target and prioritize sites on the Lower Wenatchee River for protection and restoration. The study should also contribute to the development of a coordinated, subbasin-level approach to habitat maintenance and restoration that can address issues of maintaining habitat connectivity and habitat-forming processes.
3. **Restore ecosystem functions and connectivity within the Wenatchee subbasin.** The Nason Creek, Icicle Creek, and Peshastin Creek watersheds support important populations of salmon, steelhead or bull trout, maybe only at the subwatershed level, but have experienced a greater level of habitat alteration. Connectivity may still exist or could be restored within the watershed so it is possible to maintain or rehabilitate life history patterns and dispersal. Restoring ecosystem functions and connectivity within these watersheds should be priorities as per discussion within this report, especially in the Nason Creek watershed which supports the second strongest population of spawning spring chinook in the Wenatchee subbasin.
4. **Evaluate the relationship between stream flows and water use in the subbasin.** Low instream flows and dewatering in reaches naturally occur in areas of the Wenatchee subbasin. These conditions are related to climatic and geologic conditions. However, in areas of the subbasin where water diversions and withdrawals also occur, there is often a lack of clarity and confidence as to what the cause and affect relationship is between out-of stream water use, irrigation practices, naturally occurring conditions, and instream flow in a given stream reach. The extent to which improved water conservation practices and decreased water diversion and withdrawal may improve instream flows, appreciably improving salmonid production

in a given reach, requires further data collection and analysis. Specifically, a better understanding is needed of the potential effects of the Chiwawa Irrigation District water diversion on instream flows in the lower Chiwawa River. Alternatives to improve instream flows in the lower Wenatchee River, lower Icicle Creek, Peshastin Creek, and Mission Creek need to be investigated.

5. **Increase instream low-flows negatively impacted by human impacts.** Low instream flows from July until fall rains begin, are a natural condition in the subbasin and are highly variable from year to year based on climatic conditions. This condition can be exacerbated by human-induced changes in the subbasin, potentially altering the timing and magnitude of peak and base flows. During periods of low snowpack and drought, low flow conditions can extend earlier into the summer and later into the fall months. Natural low flow conditions can be exacerbated by the diversion and withdrawal of instream flows for irrigation and domestic use during July, August, and especially September. Given the natural variation in stream flows in the Wenatchee subbasin, developing and implementing water conservation practices and water use and delivery efficiencies for all water uses subbasin-wide is critical to insuring sustainability of naturally-producing, anadromous salmonids in the Wenatchee subbasin.

Summary of Habitat Conditions by Watershed

Presented below is a summary, by watershed, of habitat conditions that have been identified by the TAC in the development of the report. A summary of habitat conditions in the Chumstick drainage (part of the Mainstem Wenatchee River Watershed) is also provided here. Its habitat issues are extensively identified in the literature and could not be adequately captured if lumped into the discussion of the mainstem Wenatchee River. A more detailed discussion of habitat conditions in each watershed can be found in the “Salmonid Habitat Conditions by Watershed” chapter of the report. Past and existing efforts to maintain and restore salmon habitat and other watershed management needs, are identified in the Northwest Power Planning Council (NWPPC) Wenatchee Subbasin Summary (2001).

Mainstem Wenatchee River Watershed (203,088 acres). Total juvenile salmonid densities in the Wenatchee River are primarily limited by the availability of high flow refuge habitat for post-emergent fry (Hillman and Chapman 1989a). Fry densities that exceed the river’s late summer rearing capacity may then be limited by available habitat quality and quantities during late summer (Hillman and Chapman 1989a). The mainstem Wenatchee River also provides overwintering habitat for juvenile spring chinook and juvenile steelhead. Since it is likely that juvenile steelhead emigrate from smaller tributaries into the mainstem Wenatchee River with the onset of colder stream temperatures, this emphasizes the importance of maintaining adequate winter rearing habitat in the mainstem Wenatchee River to accommodate an additional influx of rearing salmonids. Protecting and restoring habitat that provides both high and low flow refugia is critical to improving salmon and steelhead production in the Wenatchee subbasin. The most significant habitat impacts in this watershed include a loss of floodplain habitat and

habitat forming processes that develop and maintain habitat complexity. Water diversions and withdrawals that contribute to reduced flows during the late summer and early fall further exacerbate the problem of decreased habitat quantity and quality in the mainstem Wenatchee River during this period.

Chumstick Creek Drainage (47,000 acres). The Chumstick Creek drainage contributes approximately 0.2 % of the annual average flow to the Wenatchee River. Impacts to the channel migration zone from private land development, and sediment delivery from road densities on forest service lands, are the most important issues in this drainage and are driving habitat degradation. Many of the highly degraded habitat attributes affect channel morphology (road density and location, loss of floodplain connectivity, an alteration of disturbance regimes, loss of refugia, and loss of off-channel habitat). Additionally, instream flows are very low, upstream access is blocked at multiple locations, water quality is degraded, and high fine sediments may limit spawning success and food production (macroinvertebrate communities). The Chumstick drainage has been identified as one of the more problematic drainages in the entire Wenatchee subbasin relative to land use impacts and management issues.

Mission Creek Watershed (59,609 acres). The Mission Creek watershed contributes approximately 1 % of the annual average flow to the Wenatchee River. The largest factor contributing to the decline of spring chinook and steelhead in the watershed is dewatering, low flows, and the associated high instream temperatures in Mission Creek below Sand Creek, and in Brender Creek. Second in significance are the negative impacts to fish passage in the watershed. Fish passage barriers are created by dewatering and low flows near the mouth of Mission Creek and by culverts, dewatering/low flows, and diversion dams in the lower reaches of Brender, Yaksum, and E. Fk. Mission creeks, all major tributaries to Mission Creek. Finally, the loss of functioning habitat in the floodplain of Mission and Brender Creeks significantly reduces the production potential of the watershed. The lower reaches of these streams in their natural functioning condition, historically would have provided critical overwinter habitat for rearing juvenile salmonids in the Wenatchee subbasin, as well as a migration corridor, spawning habitat, spring high flow refugia for rearing juveniles and adult resting habitat. Channel alterations to accommodate roads, urban and residential development, and agriculture have resulted in a straightened channel without associated wetlands and riparian vegetation, that is disconnected from its floodplain and does not allow for habitat-forming processes. Along with responding to opportunities to reestablish floodplain functions, restoring upland habitat that has been impacted by harvest and road development will be necessary to restore channel functions in Mission Creek and its tributaries.

Peshastin Creek Watershed (78,780 acres). The Peshastin Creek watershed contributes approximately 4 % of the annual average flow to the Wenatchee River. The lost channel sinuosity, floodplain function, and riparian habitat (including off-channel habitat) within the channel migration zone of Peshastin Creek has had the greatest negative impact on salmonid production in the watershed and is driving habitat degradation. This impact is

caused primarily by the location of State Highway 97. Second to the impacts of lost channel function on Peshastin Creek are the impacts created by the Peshastin Irrigation District (PID) water diversion located at RM 4.8. As currently operated, the diversion negatively impacts salmon, steelhead and bull trout use in the watershed by contributing to low flow conditions that preclude adult bull trout migration, hinder spring chinook migration, and dewater the lower reach. Until the channel's ability to manage the transport and storage of water, bedload and LWD is restored to an appropriately functioning condition, and until human-induced, low flow conditions can be addressed, other salmonid habitat projects in the watershed will have a very limited or negligible affect on improving salmonid production. To improve the health and functionality of the Peshastin Creek ecosystem, habitat impacts in upper Peshastin Creek and in tributaries to Peshastin Creek must be addressed as well.

Icicle Creek Watershed (136,960 acres). The Icicle Creek watershed contributes 20 % of the annual average flow to the Wenatchee River. In the Icicle Creek watershed, natural conditions (steep gradients, water falls, flows) limit access in tributaries. However, given the total size of the watershed and the quality of the habitat, the remaining available portion of the watershed still offers a large amount of potentially productive habitat. This is dependent on fish passage through the boulder field at RM 5.6, which may vary by species and according to flow conditions. To make this upper watershed habitat accessible, habitat restoration in the lower Icicle watershed, that addresses human-induced impacts and is designed within a reach or other appropriate hydrologic unit, is necessary. The Icicle Creek watershed could then potentially contribute to: 1) maintaining bull trout populations and restoring the fluvial bull trout life history form in the Icicle Creek watershed (MacDonald et al. 2000); 2) reestablishing a strong, wild steelhead run in the Icicle Creek watershed; and 3) opening additional spawning and rearing habitat to spring chinook in the Wenatchee subbasin.

While protecting functioning floodplain and riparian habitat downstream of the wilderness boundary (RM 17.5; primarily habitat downstream of the Leavenworth National Fish Hatchery at RM 2.8), restoring full fish passage at human-made passage barriers on Icicle Creek is critical. Next, low flow conditions and associated high instream temperatures in the lower reaches of Icicle Creek from RM 5.7 at the Icicle/Peshastin Creek water diversion downstream to the mouth, negatively impact salmonid fish passage and decrease habitat quantity. Habitat degradation in the lower 3.8 miles of Icicle Creek needs to be addressed as well to fully realize the potential benefits of reestablishing connectivity between the majority of the Icicle Creek watershed and the rest of the Wenatchee subbasin. Habitat restoration projects that allow Icicle Creek to adjust to changes in flows and sediment within the channel migration zone of Icicle Creek would further improve salmonid productivity in the Icicle Creek watershed. This would include projects aimed at improving riparian habitat functions and floodplain functions.

Chiwawa Creek Watershed (117,000 acres). The Chiwawa River watershed contributes 15 % of the annual average flow to the Wenatchee River. Maintaining fish passage through the lower reach of the Chiwawa River is critical to sustaining spring

chinook, steelhead, and bull trout populations in the Wenatchee subbasin. Although impacts to the naturally functioning condition of the lower Chiwawa River have occurred, passage is not yet thought to be hindered. Protecting functioning floodplain and riparian habitat is the highest priority in this watershed, especially in the vicinity of the Chikamin Creek confluence. Investigating the extent to which the Chiwawa Irrigation Diversion (CID) contributes to elevated instream temperatures in the lower 3.5 miles of the Chiwawa River is second in priority. If water temperatures are or become substantially elevated in late summer in the lower Chiwawa river, the existing excellent connectivity of this watershed with important habitat throughout the Wenatchee subbasin could be weakened. Habitat in the watershed above Chikamin Creek (RM 13.8) is largely pristine. Brook trout should also be noted as one of the greatest threats to bull trout populations in the Chiwawa watershed. To date no brook trout have been observed in the upper watershed, but brook trout are well established in the lower watershed (especially in Chikamin Creek) and no barriers hinder brook trout access to the upper watershed.

Nason Creek Watershed (69,000 acres). The Nason Creek watershed contributes 18 % of the annual average flow to the Wenatchee River. The significance of the Nason Creek Watershed lies in its potential contribution to spring chinook production in the Wenatchee subbasin and its connectivity to the upper Wenatchee subbasin salmonid populations, especially the bull trout subpopulation. Maintaining the remaining functioning floodplain and riparian habitat is the first priority in the Nason Creek watershed. Habitat restoration projects that allow Nason Creek to adjust to changes in flows and sediment within the channel migration zone is second in priority. This would include projects aimed at improving riparian habitat functions and floodplain functions, especially reconnecting off-channel habitat to the extent it is determined to cumulatively show an appreciable improvement in channel function. Habitat restoration projects aimed at reducing sediment delivery to stream channels from human-induced causes should be the third in priority. The location of highways, railroad and powerline corridors adjacent to Nason Creek have confined and straightened the channel in places. Timber harvest, road development and conversion of the floodplain to residential uses in Nason Creek and its tributaries from RM 15.4 downstream have degraded and reduced spawning and rearing habitat in the watershed.

White/Little Wenatchee River Watershed (175,285 acres). The White and Little Wenatchee River combined contribute 40% of the annual average flow to the Wenatchee River (25% and 15%, respectively). Maintenance of functioning floodplain and riparian habitat, including shallow water habitats and shoreline habitat of Lake Wenatchee, is the highest priority in this watershed. Loss of floodplain function on the White and the Little Wenatchee Rivers is the greatest threat to salmonid production in the White/Little Wenatchee Watershed. The White and the Little Wenatchee Rivers have among the best aquatic habitat and strongest native fish populations anywhere in the Columbia basin (USFS 1998m). The connectivity between these two watersheds and other good aquatic habitat is also among the best in the Columbia basin. Their connectivity to a large, undammed lake, Lake Wenatchee, also adds to their high regional value (USFS 1998m). Much of the reason for the high aquatic health of these watersheds is that in the depositional reaches near the mouth of both rivers, both the structurally complex,

meandering channels and the broad, wetland-filled floodplains remain largely undeveloped, despite the presence of considerable private land.

Reducing the effects of road density and location in the Little Wenatchee River drainage is second in priority in the watershed, with emphasis on Rainy Creek and the Little Wenatchee River from the mouth upstream to Cady Creek (RM 16.9), followed by restoring wetland connectivity and function in the vicinity of the Lake Wenatchee inlet. Additionally, timber harvest within riparian areas on the mainstem Little Wenatchee and Rainy Creek has further reduced potential LWD recruitment, altered runoff and water storage patterns, and increased fine sediment input into receiving waters. Restoring wetland connectivity and function is second to habitat protection in the White River drainage.

WRIA 40 Squilchuck, Stemilt and Colockum Watersheds (96,882 acres). The extent to which these watershed can support salmon and steelhead/rainbow trout is most strongly limited by the natural hydrology and geology in these low precipitation watersheds. Because of the reliance on snow accumulation and snowmelt to support instream flows and the high permeability of the soils, perennial flows are not supported in many areas limiting access to habitat. This condition is worsened during low water years. Given the natural geology of the watershed, chinook salmonid use is naturally limited to the lowest reach of the tributaries to the Columbia River, before steep channel gradient precludes upstream fish passage. Adult steelhead trout could naturally penetrate higher into the watershed on good water years, given passage at culverts and diversion dams. However, intermittent flows later in the year, coupled with severe habitat degradation present significant limitations to steelhead/rainbow productivity in these watersheds. The status and distribution of the native redband trout populations is unknown for these watersheds.

Wenatchee Subbasin Inventory and Assessment Data Gaps

Following are the overriding subbasin-level inventory and assessment data gaps for the Wenatchee subbasin. Obtaining this information will increase the ability of the public and technical staff to make natural resource management decisions at the subbasin-level with a higher degree of confidence in the outcomes. Data gaps at the watershed level are listed in the “Salmonid Habitat Conditions by Watershed” chapter of the report.

- A study is needed to define current floodplains and riparian habitat in the Wenatchee River corridor in terms of channel form and process. This would contribute to the development of a habitat protection and restoration strategy that would address issues of maintaining habitat connectivity and habitat-forming processes. Chelan County has initiated a Channel Migration Zone Study of the Wenatchee River from the bottom of Tumwater Canyon downstream to the Columbia River confluence, including the lower 4.0 miles of Nason Creek. Supplemental studies may be needed.
- A hydrologic assessment is needed to evaluate groundwater and surface water interactions (including the effect of water diversions and withdrawals on ground and

surface water), identify critical ground water recharge areas, and identify locations where groundwater contributes to surface water in the Wenatchee River corridor, including the alluvial fans. A measure of the affect this interaction has on moderating high summertime stream temperatures and low summer/fall instream flows should be included. These factors should be addressed by the Watershed Planning Unit in Phase II of Wenatchee Watershed Planning (RCW 90.82).

- More information is needed on bull trout distribution and habitat use for all life history forms found in the Wenatchee subbasin (fluvial, adfluvial, and resident). The extent of habitat fragmentation (i.e. water crossing structures, thermal barriers, dewatering/low flows) on bull trout, both its causes and affects, is needed.